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APPRAISAL OF DAMAGE BY THE YELLOWHEADED SPRUCE SAWFLY, CHIPPEWA NATIONAL FOREST - 1979

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INTRODUCTION

The yellowheaded spruce sawfly, Pikonema alaskensis (Rohwer), is a common defoliator of white spruce (Picea glauca (Moench) Voss) plantations on the Chippewa National Forest in Minnesota. A 1979 survey of 50 white spruce plantations on the forest showed that 88 percent were infested by sawfly[1/].

Although many trees may be attacked in a plantation, the amount of damage may be of no consequence. In such cases, sawfly colonies are small, widely dispersed, and unsuccessful in completing their larval stages. These light attacks have no impact on tree growth rates because spruce can tolerate up to 30 percent defoliation each year without affecting growth. In some cases, when most trees in a plantation are attacked, defoliation may be heavy and growth rates will be adversely affected. Some trees may die if they are heavily defoliated for several consecutive years.

Sawfly infestations were high on 11 of the plantations surveyed in the spring of 1979.[1/] These plantations, and one other, were surveyed again in November 1979 to determine sawfly damage levels.

OBJECTIVE

The objective of this survey was to determine the degree of defoliation of white spruce caused by yellowheaded spruce sawfly in 1979 on 12 plantations of the Chippewa National Forest.

[1/] Ford, Robert P. Unpublished data.

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METHOD

The 12 plantations surveyed were located on the Cass Lake, Black Duck, Marcell, and Walker Ranger Districts (Table 1). Each plantation was divided into three approximately equal-sized areas. A single row of trees within each area and a tree within the row was arbitrarily selected for sampling. The starting point tree and 99 other white spruce in the same row were examined for sawfly defoliation. When examination of 100 trees within the row was completed, the sampling process was repeated in the second and third areas. The 300 white spruce constituted the sample for the plantation. Some plantations were made up of several blocks and were given separate stand designations by the foresters on the district. The blocks in a compartment were all planted the same year; therefore, they were treated as one plantation for this survey (Table 1).

Tree damage was classified as: trace, 0-10 percent current defoliation; light, 11-25 percent current defoliation; moderate, 26-50 percent current defoliation; heavy, over 51 percent current defoliation or dead trees.

RESULTS

Three of the plantations where the frequency of trees attacked was very high suffered very little damage. Although sawflies persisted in attacking the trees, defoliation was not intense on any particular tree. In four plantations frequency of trees attacked was very high, but damage was moderate. In these plantations, 13 to 22 percent of the trees were moderately to heavily defoliated in 1979. In five plantations most trees were attacked, and 20 to 76 percent were moderately to heavily attacked. Some dead trees were tallied in four of these plantations (Table 2). Defoliation levels seem to have decreased compared to the last two years of attack, but defoliation remains at moderate to high levels throughout the forest.

DISCUSSION AND RECOMMENDATIONS

This sawfly usually attacks the same trees each year and attacks new trees as its population gradually increases. In 1979, however, trees in a plantation that had never before been attacked were defoliated, and trees in the same plantation that had been defoliated for 3 consecutive years were not attacked. The new attacks seemed to be on the higher, drier sites whereas trees on the lower, wetter sites were not attacked. This change of locations within plantations probably came about because overwintering larvae in the soil did not survive during the drought years of 1976-1979 on the drier portions of the stand or during the previous winter on the wetter sites.

Shading of white spruce is sometimes used as a method to prevent sawfly attack, but during this survey we saw many shaded spruce that were heavily defoliated by the sawfly. To be effective, the shading must be on all sides and above the spruce. If the spruce is under the canopy of the shading hardwoods, it may be attacked; but it appeared that if the hardwoods are about 8 or more feet taller than the spruce, sawfly attack is unlikely. Shading of host trees is probably the reason naturally seeded spruce is not attacked. We observed many naturally seeded white spruce, growing in open situations, that were defoliated by yellowheaded spruce sawfly. Even 50-feet tall spruce had defoliation on some of the lower branches.

Several alternatives are available for managing white spruce to prevent defoliation by yellowheaded spruce sawfly.

1. Grow white spruce under a protective canopy of hardwoods that cast a light shade. Hardwoods such as aspen or paper birch are suitable. Physical damage to the spruce will have to be prevented by removing hardwood trees whose branches or stems beat against the spruce. The spruce will not grow as fast as open-grown trees that are not attacked by sawfly. In Saskatchewan, overtopped white spruce needed 8.7 years to reach a diameter at breast height that was achieved by open-grown spruce in 7.1 years (Cayford 1957). The 2-year difference would likely double in stands managed for sawfly control because spruce would have to grow to about 10 feet before being released. Much of the growth loss in Saskatchewan was caused by hardwoods whipping the spruce leader. Mulloy (1941) found no adverse effect on white spruce, red spruce, or balsam fir growing under paper birch in Quebec. These investigations were in natural stands.

   The most obvious drawbacks to growing spruce under poplar or birch are the increased cost of planting, the establishment of the nurse crop, the cost of spruce release by hand methods, and the damage that could occur to sapling spruce when the nurse crop is removed.

2. Control destructive populations of sawfly with an insecticide after complete biological, environmental, and economic evaluations indicate a need. Since only about 30 percent or 220 acres a year would have to be treated, the cost of air application of insecticide would be prohibitive. Any one plantation would need one or two applications in its rotation.

   A programmatic environmental statement could be written to cover all spruce sites on the forest, but the biological and economic evaluations would change each year as sawfly populations and cost factors change.

3. Plant white spruce on sites that are unfavorable to yellowheaded spruce sawfly. Cook[2/] studied the influences of soil and site on the sawfly near Grand Rapids, Minn. His data indicate that sites with at least 32 pounds of nitrogen per acre in the tree root zone, a low percentage of clay at a soil depth of 12 inches, a high percentage of sand at a soil depth of 24 inches, and a thick B2 & 3 horizon will likely suffer little defoliation by yellowheaded spruce sawfly. These factors need to be tested for applicability on a stand basis, and such an investigation is projected for 1980.

4. Fertilize currently infested stands to improve tree growth rate and to make foliage less attractive to sawflies. Cook[2/] found that the foliage of heavily attacked spruce lacked manganese, but had too much magnesium and potassium. His investigation was not to determine whether defoliation caused nutrient imbalance or if the imbalance invited defoliation. Other factors such as rank growth of weeds, increased attack by aphids, and perhaps more damage by hares must be considered because fertilizer has caused these changes in other instances.

5. Plant alternate species. This sawfly will eat any species of spruce, so alternatives could be poplar, white pine, larch, or fir. All these species have their major pests that are equal to or worse than the sawfly on spruce. On the heavier soils, where much spruce is now planted, white pine would probably be heavily weeviled. This kind of site usually includes swamps and potholes where Ribes (alternate host of white pine blister rust) flourishes and where atmospheric conditions enhance spore dispersal. Larch would grow well on the same kind of sites, but larch sawfly is about as destructive as other sawflies.

Forest Insect and Disease Management favors alternatives 3 and 5. If soil analysis shows that Cook's[2/] data apply to presently defoliated and nondefoliated plantations on the Chippewa National Forest, future planting of white spruce could be limited to sites where sawfly damage is expected to be light. On other sites another tree species should be planted.

[2/] Cook, J. L. unpublished data.

LITERATURE CITED

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Table 1.--White spruce plantations surveyed for yellowheaded spruce sawfly damage, Chippewa National Forest, 1979

Ranger district	Compartment no.	Stand no.	Number of acres
Cass Lake	5	4, 5	36
Cass Lake	135	1	6
Cass lake	56	2, 16	66
Marcell	136	6, 9, 10, 15, 18, 19, 21	156
Marcell	151	2	16
Marcell	32	1, 3, 6	56
Marcell	113	6	34
Marcell	90	1	19
Black Duck	17	21	100
Black Duck	23	3, 4	72
Black Duck	71	11, 16	33
Walker	37	4	16

Table 2.--Percentage of trees in defoliation categories and tree loss caused by yellowheaded spruce sawfly on selected white spruce plantations, Chippewa National Forest, 1979

Plantation	Comp. no.	Defoliation category				
		Trace	Light	Moderate	Heavy	Dead
Cass Lake	5	56	22	10	10	2
Cass Lake	135	38	20	17	23	2
Cass Lake	56	90	9	1	0	0
Marcell	136	51	21	12	14	2
Marcell	151	69	18	8	5	0
Marcell	32	86	9	4	1	0
Marcell	113	55	23	12	10	0
Marcell	90	72	15	9	4	0
Black Duck	17	76	16	6	2	0
Black Duck	23	59	20	11	10	0
Black Duck	71	60	15	11	14	0
Walker	37	9	13	23	53	2